



# **SWOT and NISAR Mission Operations for CNES Visit November 14, 2017**

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# Overview

- Both Surface Water Ocean Topography (SWOT) and NASA ISRO SAR (NISAR) missions are radar mission with international cooperation, with JPL providing radar instruments and foreign partners providing s/c bus
  - SWOT with CNES
  - NISAR with ISRO
- Each institution maintains and operates the hardware they provide

Category	JPL	CNES	ISRO
Science Downlink	NISAR	SWOT	NISAR
Engineering Downlink		SWOT	NISAR
Spacecraft Operation (Command generation and health & status)		SWOT	NISAR
Payload Operations (Command generation and health & status)	Joint	Joint	Joint
Observation Planning with science team	Joint	Joint	Joint
Command Uplink		SWOT	NISAR
Navigation	Joint	SWOT	Joint
Science Data Processing	Coordinated	Coordinated	Coordinated

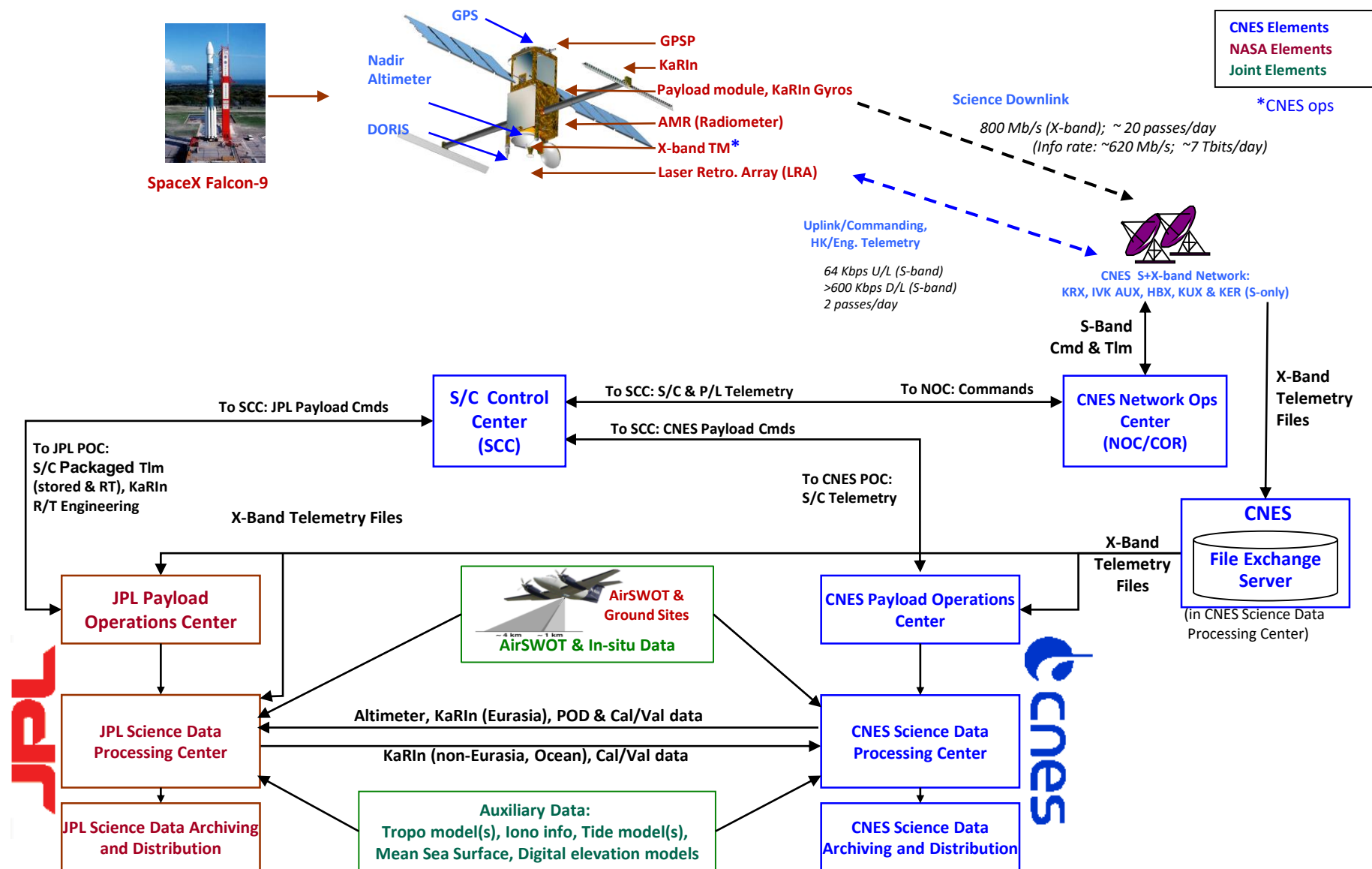


# SWOT and NISAR MOS/GDS Key Features

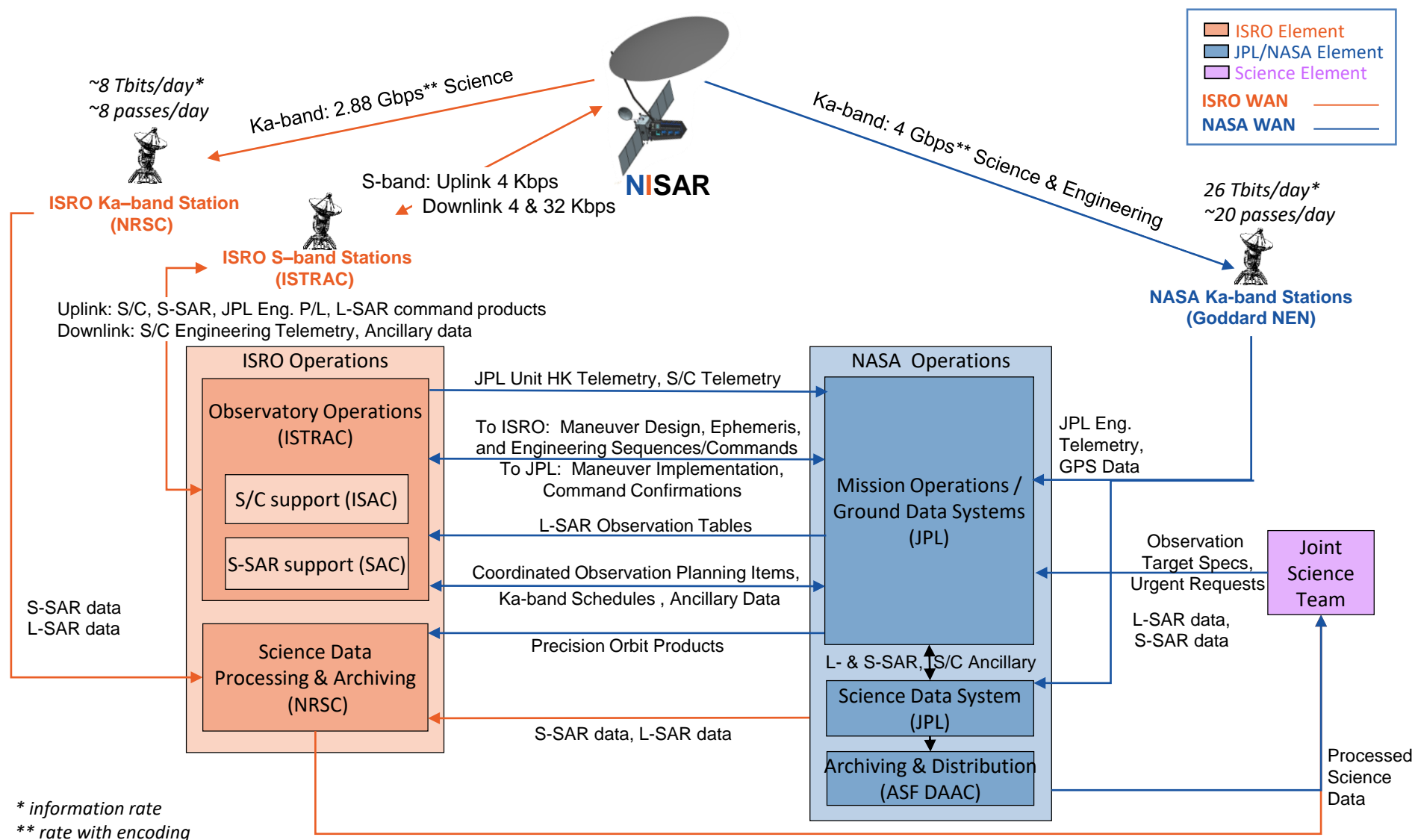
- Inherit from SMAP MOS/GDS implementation and establish multi-mission development and operations environment between SMAP, SWOT and NISAR
- Strong emphasis on automation
  - Telemetry Processing and alarm notification
  - Science data processing
  - Routine uplink product generation
- Use cloud architecture for both engineering and science data processing and management
- High bandwidth network for data transfer between institutions
- Automation, cloud architecture and high bandwidth network enable the short turn around time to support urgent responses



# SWOT Mission System Architecture



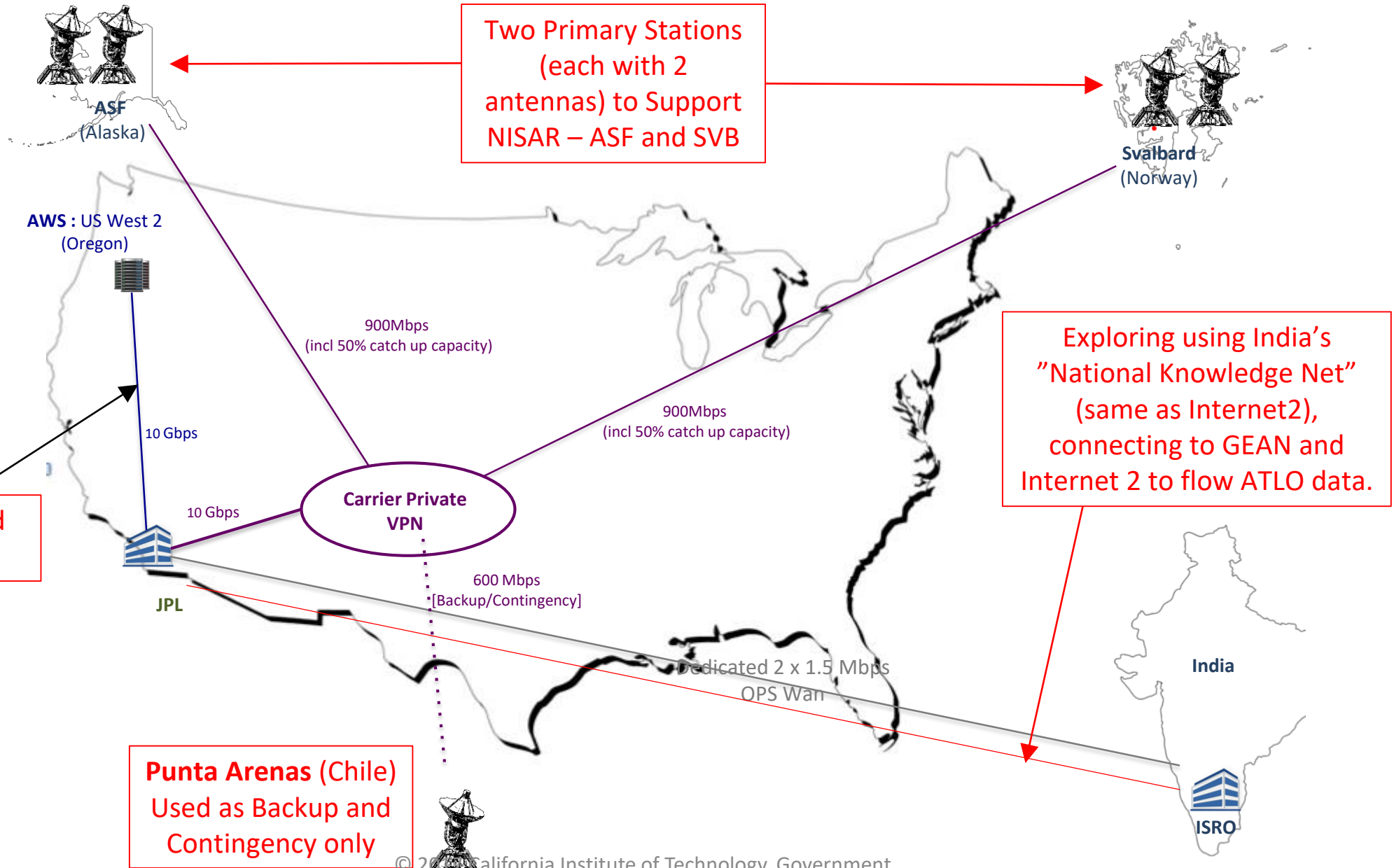
# NISAR Mission System Architecture



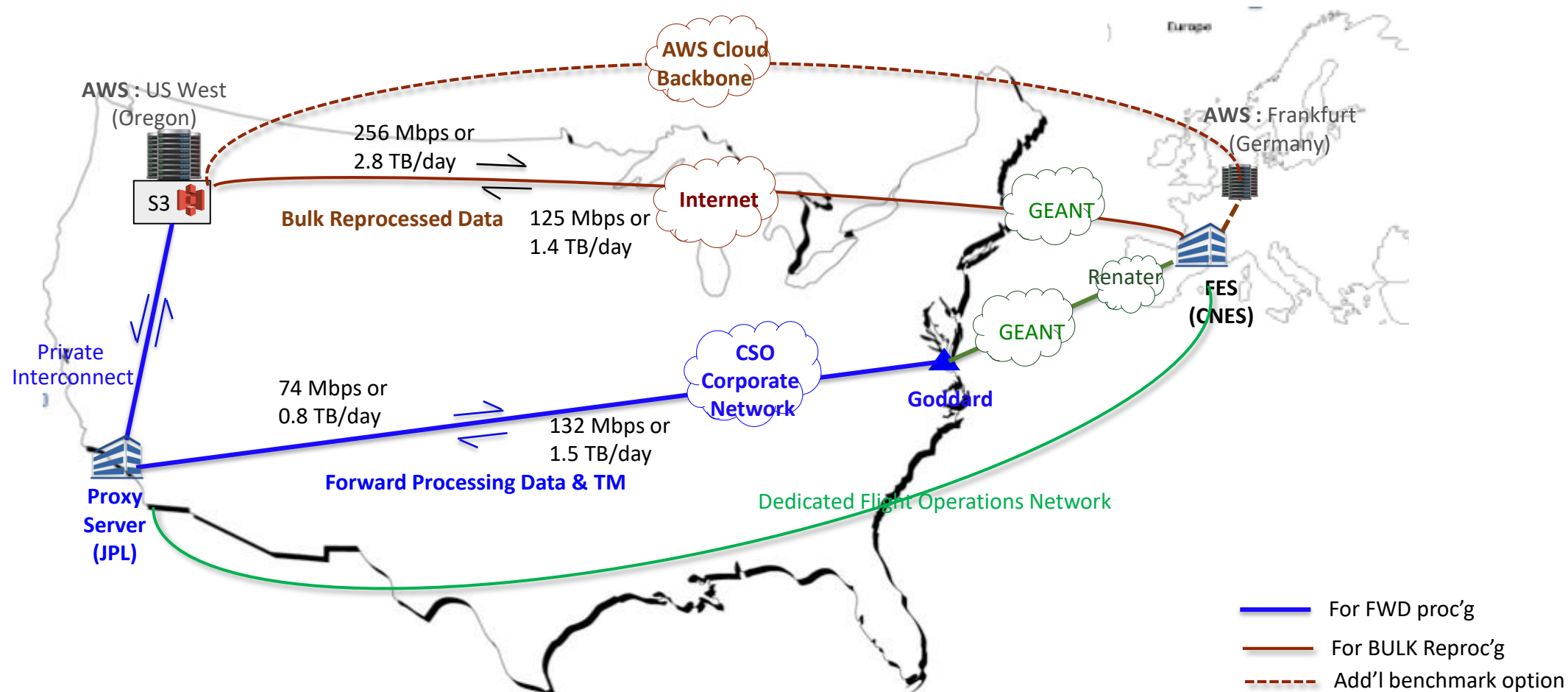
\* information rate  
\*\* rate with encoding



# NISAR Ground Antenna and Wide Area Network (WAN)

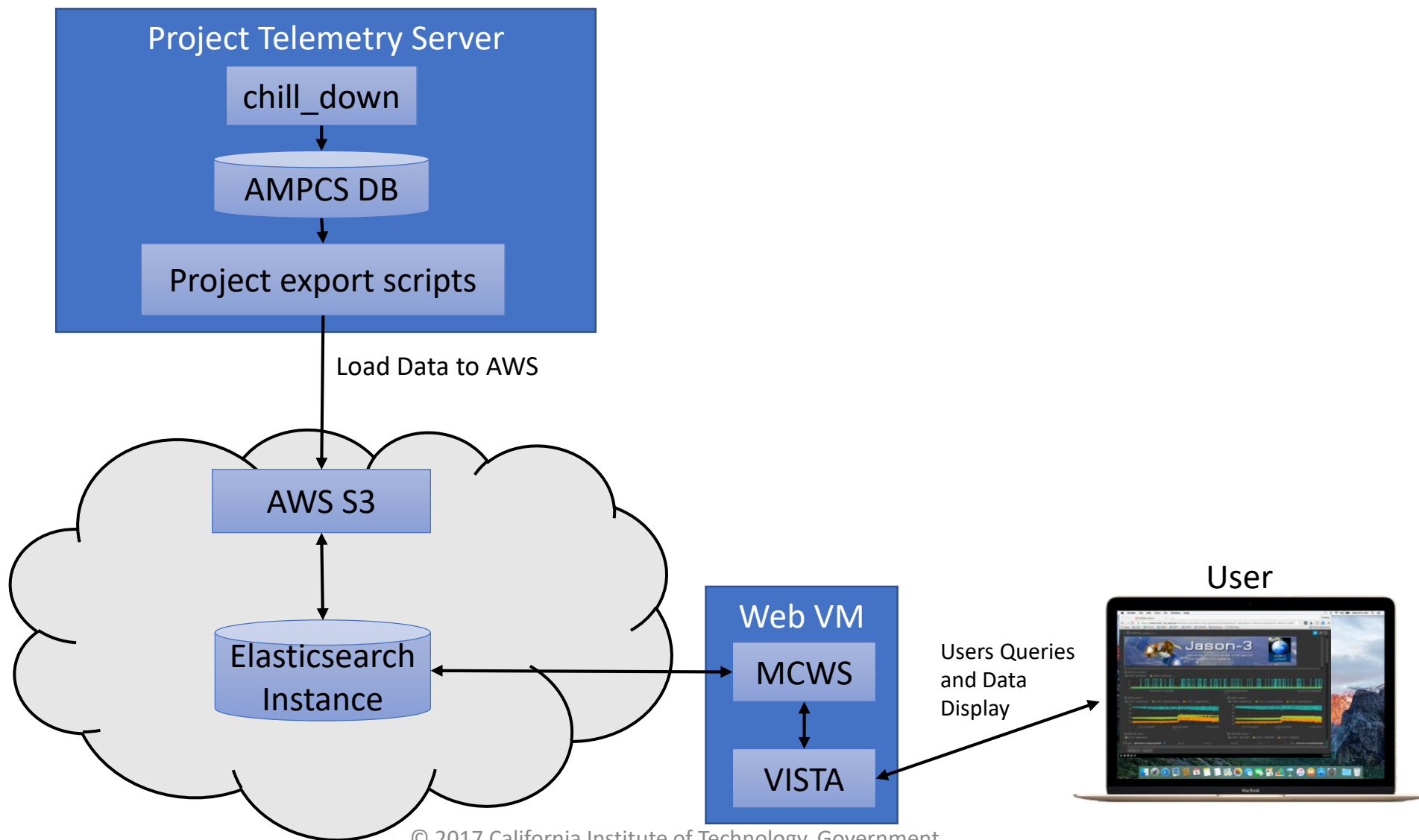


# SWOT Wide Area Network (WAN) Updates (in red)





# Generic Cloud Architecture for Engineering Data







# Backup

# SWOT Introduction

- SWOT will provide a quantum improvement for oceanography and hydrology:
  - Oceanography: First global determination of the ocean circulation, kinetic energy and dissipation at high resolution
  - Hydrology: First global inventory of fresh water storage and its change on a global basis
- Mission is a major partnership between NASA and CNES, with additional collaborations with the Canadian Space Agency (CSA) and the UK Space Agency (UKSA)
- NASA and CNES are building upon a 20 year history of successful partnership in Ocean Altimetry (Topex/Poseidon, Jason-1/2/3)
- NASA and CNES have successfully completed
  - Mission Concept Review (Sep 2012)
  - System Requirements Peer Review (Oct 2013)
  - Mission Definition Review (May 2014)
  - System Interface Review #1 (Nov 2015)
  - Project Preliminary Design Review (Apr 2016)
- NASA and CNES are preparing for the project CDR (Feb 2018)





# SWOT Mission Concept

## Mission Science

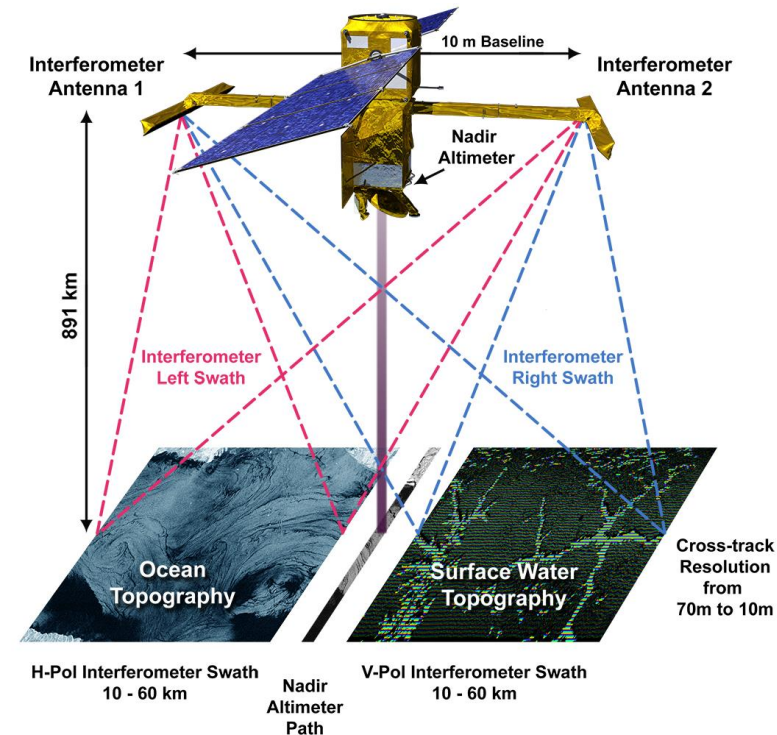
**Oceanography:** Characterize the ocean mesoscale and sub-mesoscale circulation at spatial resolutions of 15 km and greater.

**Hydrology:** To provide a global inventory of all terrestrial water bodies whose surface area exceeds  $(250\text{m})^2$  (lakes, reservoirs, wetlands) and rivers whose width exceeds 100 m (rivers).

- To measure the global storage change in fresh water bodies at sub-monthly, seasonal, and annual time scales.
- To estimate the global change in river discharge at sub-monthly, seasonal, and annual time scales.

## Mission Architecture

- Ka-band SAR interferometric (**KaRIn**) system with 2 swaths, 50 km each
- Produces heights and co-registered all-weather imagery
- Use conventional Jason-class altimeter for nadir coverage, **radiometer (AMR)** for wet-tropospheric delay, and **GPSP/DORIS/LRA** for POD.
- On-Board interferometric SAR processing over the ocean ( $500\text{m}^2$  resolution) for data vol. reduction.



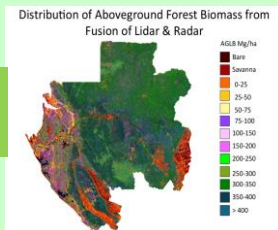
- Partnered mission with CNES & CSA
- Science mission duration of **3 years**
- Cal orbit: 857 km, 77.6° Incl., 1 day repeat
- Science orbit: 891 km, 77.6° Incl., 21 day repeat
- Flight System: ~2400kg, ~2100W
- Launch Vehicle: NASA Medium/Intermediate class
- Cat 2 Project, Risk Class: C
- Target Launch Readiness: **Apr 2021**



# NISAR Mission Overview

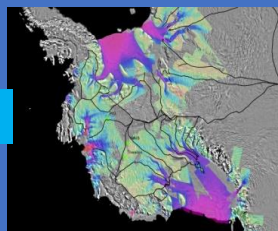
## Mission Science

### Ecosystem Structure



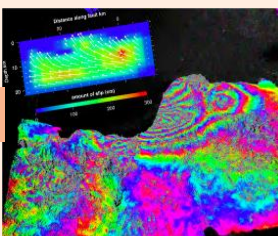
Biomass disturbance,  
Effects of changing climate on  
habitats and CO<sub>2</sub>

### Cryosphere



Ice velocity, thickness  
Response of ice sheets to  
climate change & sea level rise

### Solid Earth



Surface Deformation  
Geo-Hazards  
Water Resource Management

- Directed mission within the Earth Systematic Missions Program under NASA Earth Science Division
- Major international partner: Indian Space Research Organization (ISRO)
- Target launch date: December 2021
- Dual frequency L- and S-band Synthetic Aperture Radar (SAR)
  - L-band SAR from NASA and S-band SAR from ISRO
- Sweep SAR technique (large swath) for global data collection
- Baseline orbit: 747km altitude circular, 98 degrees inclination, sun-synchronous, dawn-dusk (6 AM – 6 PM), 12-day repeat
- Repeat orbit within +/- 250m
- Spacecraft: ISRO I3K
- Launch vehicle: ISRO Geosynchronous Satellite Launch Vehicle (GSLV) Mark-II (4-m fairing)
- 3 years NASA science operations (5 years consumables)
- 5 years ISRO S-band SAR and spacecraft operations
- All science data (L- and S-band) will be made available free and open, consistent with the long-standing NASA Earth Science open data policy.